Overview of Concept of Operations

NAJPTC Program

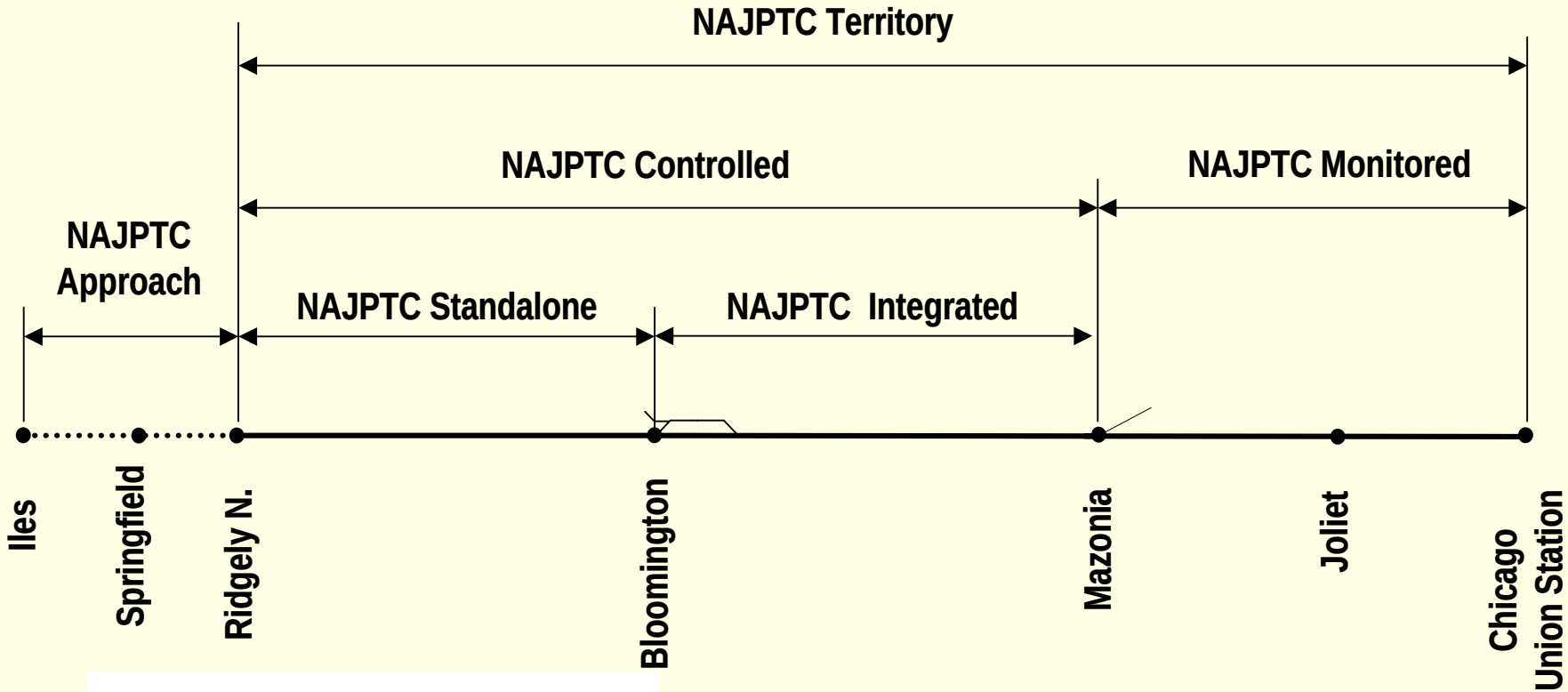
Outline

- **Key System Requirements**
- **Overview of Concept of Operations**
- **Impact on Rules & Procedures**

System Objectives

- **Must not prevent any operation that can legitimately be performed today**
- **Shall be in conformance with all existing Operating Rules**
- **Must not be impose operating constraints not experienced today - must not be more cumbersome to use**
- **Design must be flexible and permit incremental implementation (migration)**
- **Must be cost-effective**
- **Shall support core PTC objectives**

Overview of NAJPTC Territory



Note:

Spurs: non-controlled
Yard Tracks: non-controlled
Industry Tracks: non-controlled
CTC Sidings: controlled

Scope of Operations

- **Continuous display & enforcement of Authorities & Restrictions**
  - 12 Passenger Locomotives (for high speed operation)
    - Chicago-St. Louis trains 110 mph
    - Texas trains 90 mph
  - Selected freight (particularly road switchers)
- **Continuous text display of Authorities only (no enforcement)**
  - 2 MoW Hirail Patrol Vehicles
  - 1 IDOT Hirail
- **Accommodation for non-communicating trains**

NAJPTC Functionality Included Trains

- **Train Tracking**
- **Maintenance, Data Delivery & Continuous Display of Bulletins (Speed Management)**
- **Data Delivery & Continuous Display of Authorities (Authority Management)**
- **Route Integrity Monitoring**
- **Warnings & Enforcement of**
  - Authority Limits
  - Speed Restrictions
  - Maintenance of Way Work Limits

NAJPTC Functionality Included Trains (cont.)

- **Locomotive Switch Control**
- **Advance Activation of Crossing Warning Systems**
- **Interface with Train Defect Detectors**
- **Emergency Handling**
- **GCOR Rule 6.30 - Protection of Entraining and Detraining Passengers**
- **Pacing**

NAJPTC Functionality Included Roadway Worker Terminal

- **Request Form A Speed Restrictions, Form B Work Limits & Release of Speed Restrictions (Speed Management)**
- **Data Delivery & Continuous Display of Authorities (Authority Management)**
- **Display of Emergency Warnings**

Train Initialization

- **Powering up locomotive system**
  - All hardware checked automatically
  - All software checked for integrity
  - Software version number checked to verify it is current

Train Initialization (cont.)

- **Train Initialization**
  - CAD sends train consist to PTC
  - Default train data used initially until train length can be verified
  - Some manual entry required
    - train type
    - train orientation
    - track, if LDS cannot determine which track

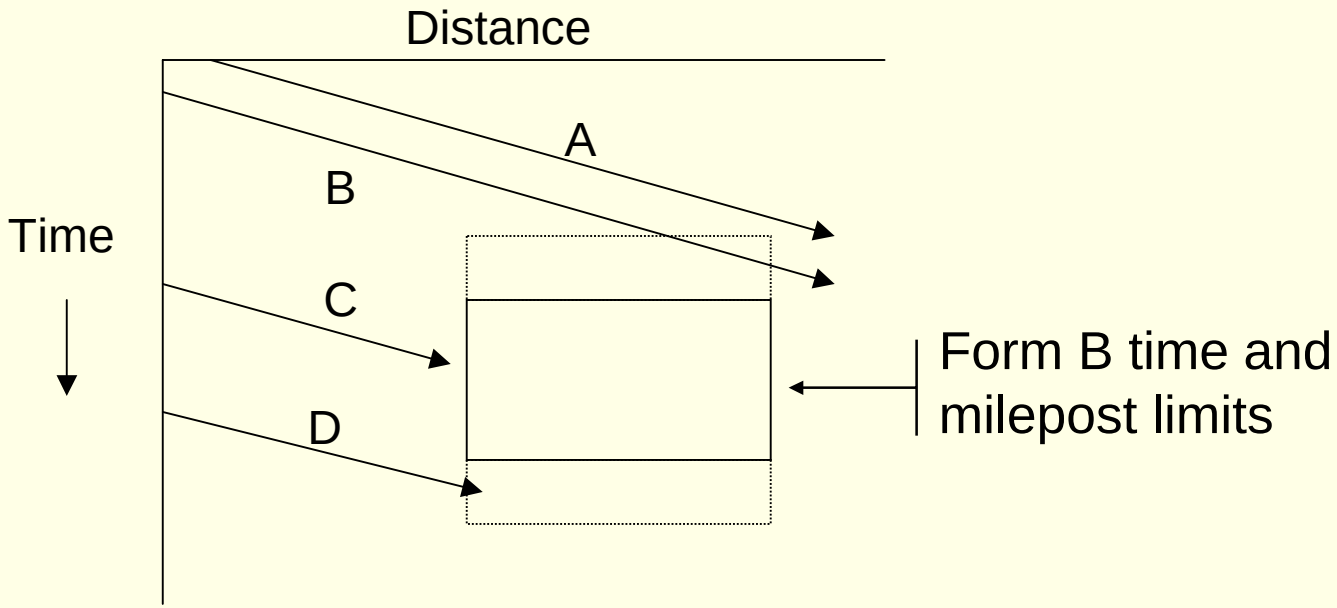
Train Tracking

- **All track circuits between adjacent signals are monitored**
- **All trains are tracked through monitoring track circuits**
- **Equipped trains have GPS/INS Location Determination System (LDS)**
  - within 10 feet along the track
  - by track
- **Reports train location on basis of time and events**

Speed Management

- **PTC maintains Permanent Civil Speeds**
- **Preparation & Distribution of Bulletins**

Operating through Form B Work Limits



- **Form B not displayed to Train A**
- **Form B displayed to Trains B & C**
  - acknowledgement required
- **Form B displayed to Train D -**
  - acknowledgement not required

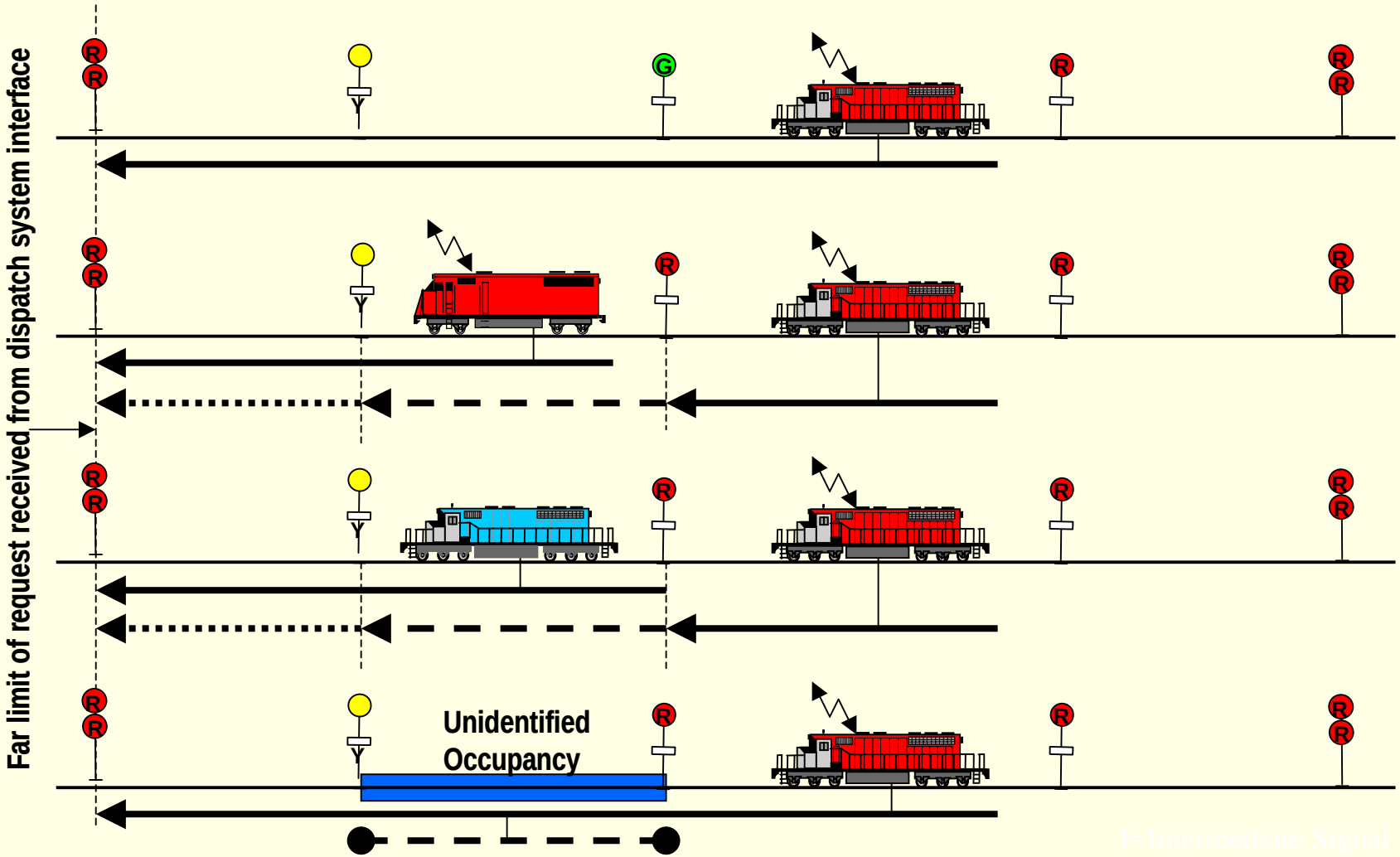
Authority Management

- **Signal-based Authorities**
  - based on field signal indications matched to dispatcher switch & signal requests
  - Integrated Territory - fixed block operation
    - authorities displayed to match authorities conveyed by wayside signals
  - Standalone Territory - moving block operation
    - Authorities displayed in Cab
    - PTC Aspect for communicating trains
    - Non-communicating trains use conventional signal aspects

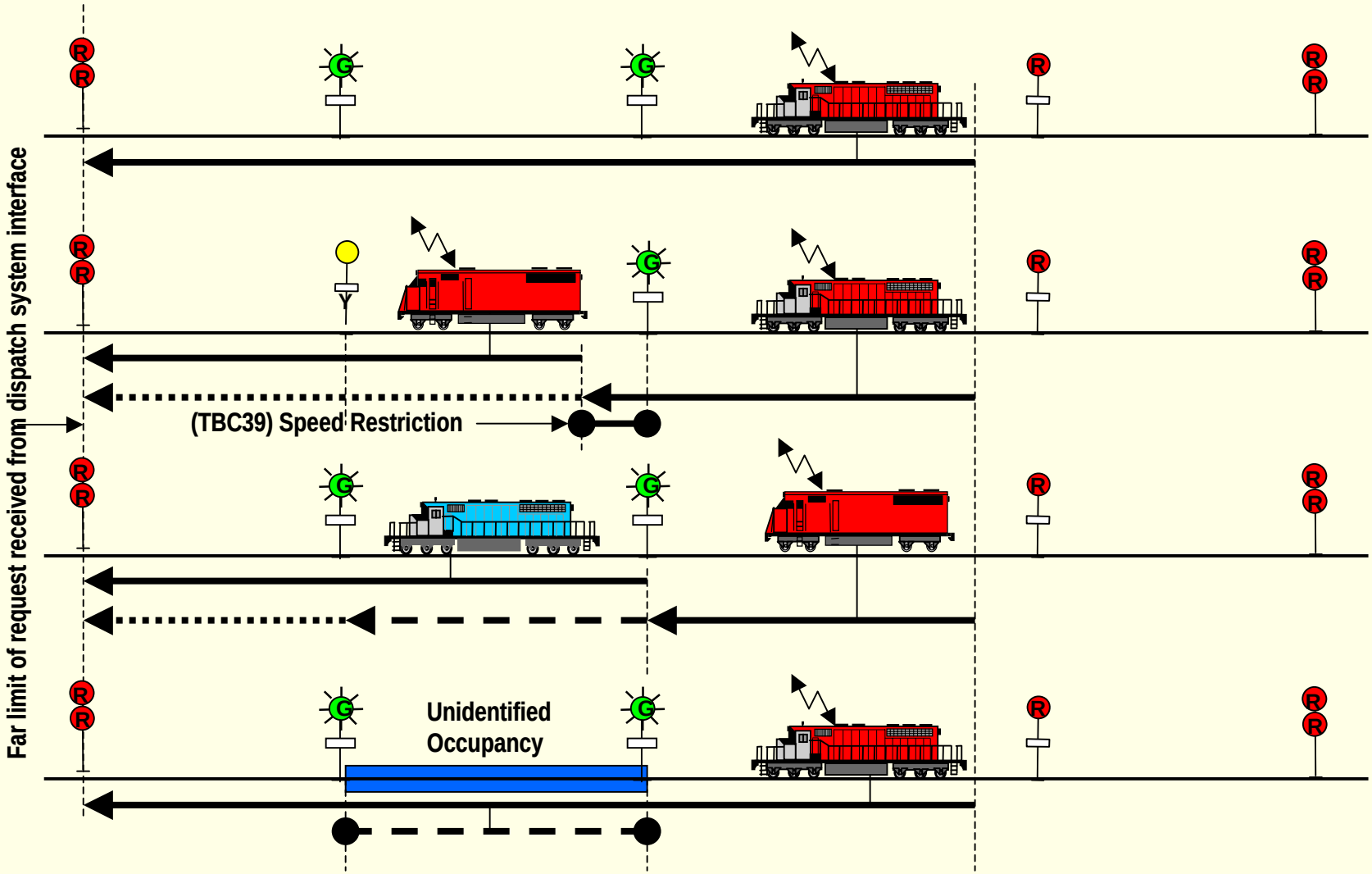
Authority Management (cont.)

- **Forms-Based Authorities**
  - Track and Time (Work Authorities)
    - Conveyed to both equipped trains and Roadway Workers
  - Permission to Pass Signal at Stop
  - Permission to Enter Main Track between Control Points

Authorities In Integrated Territory

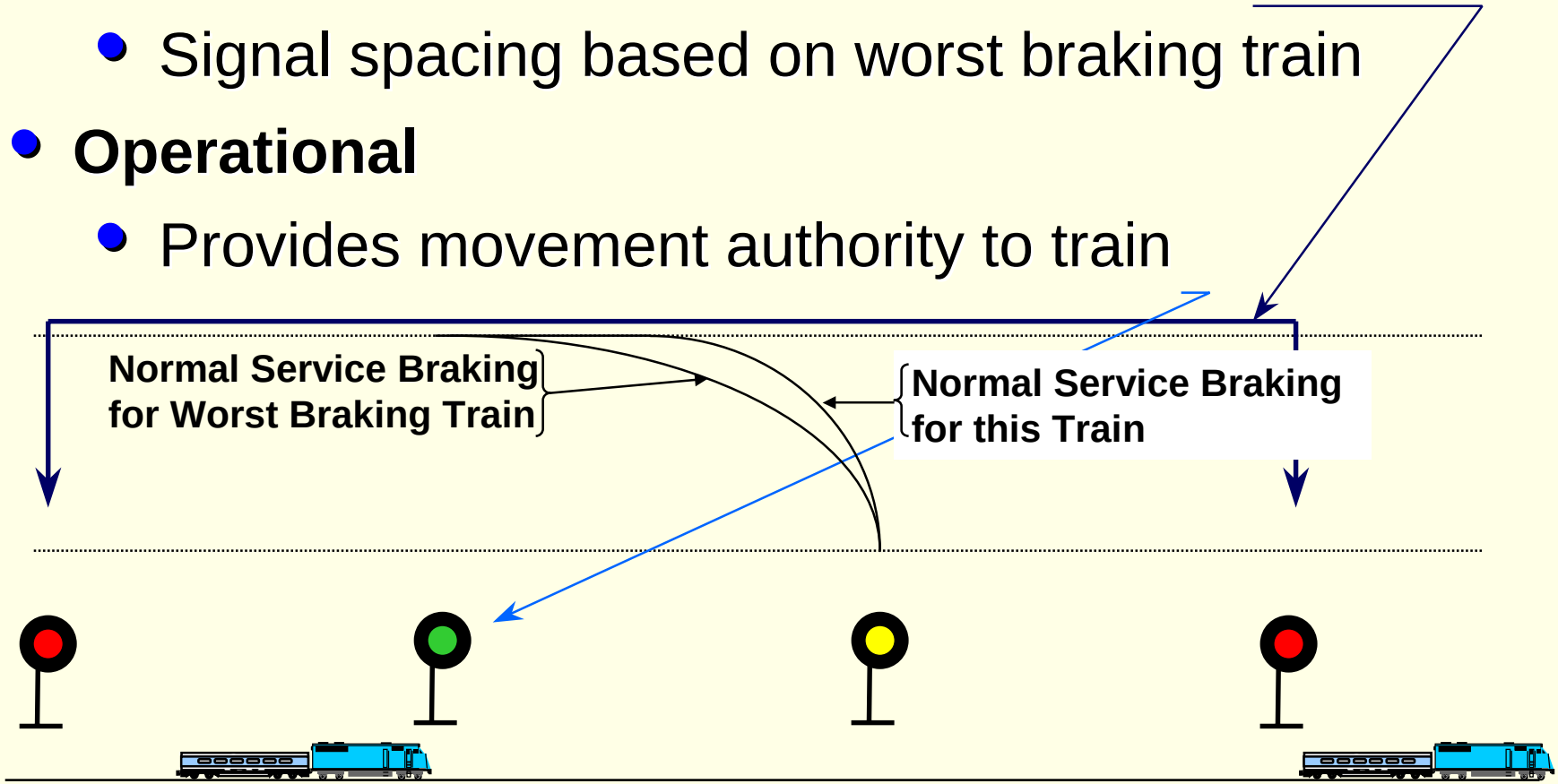


Authorities In Standalone Territory



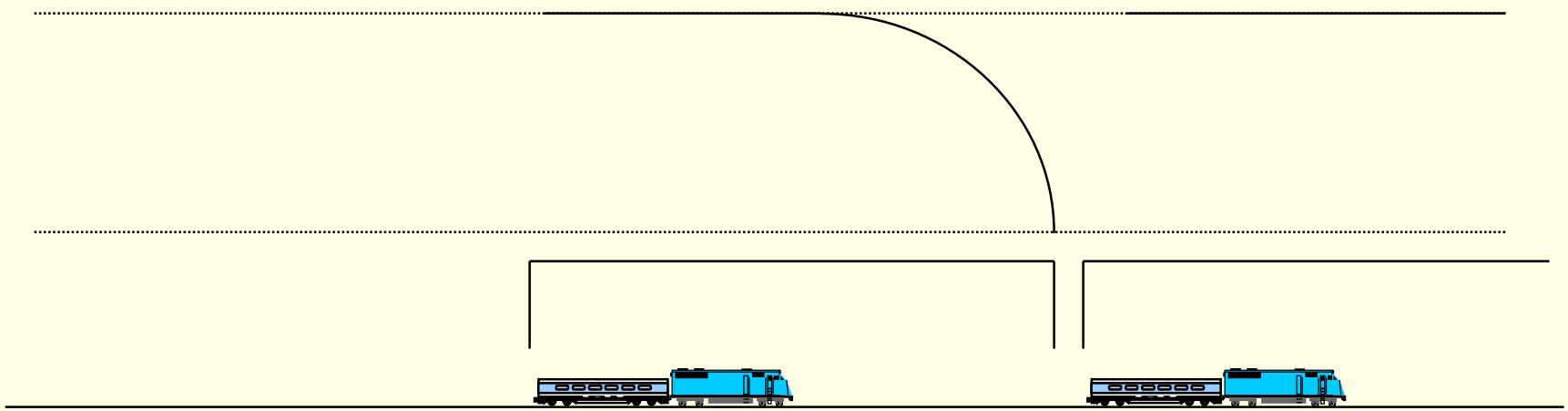
Role of Conventional Signaling

- **Safety**
  - Provides exclusive occupancy for train
  - Signal spacing based on worst braking train
- **Operational**
  - Provides movement authority to train

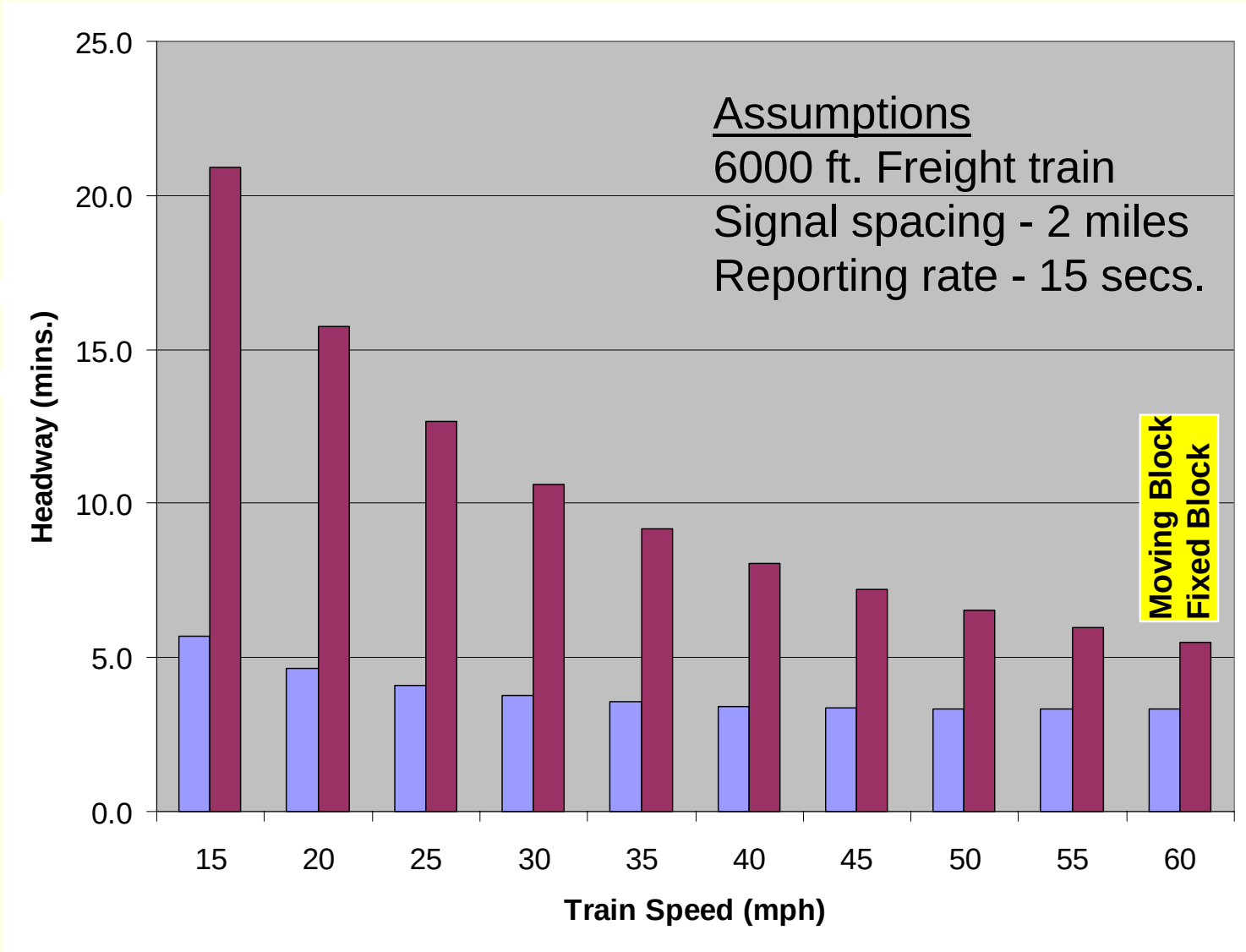


CBTC - Communications-Based Train Control

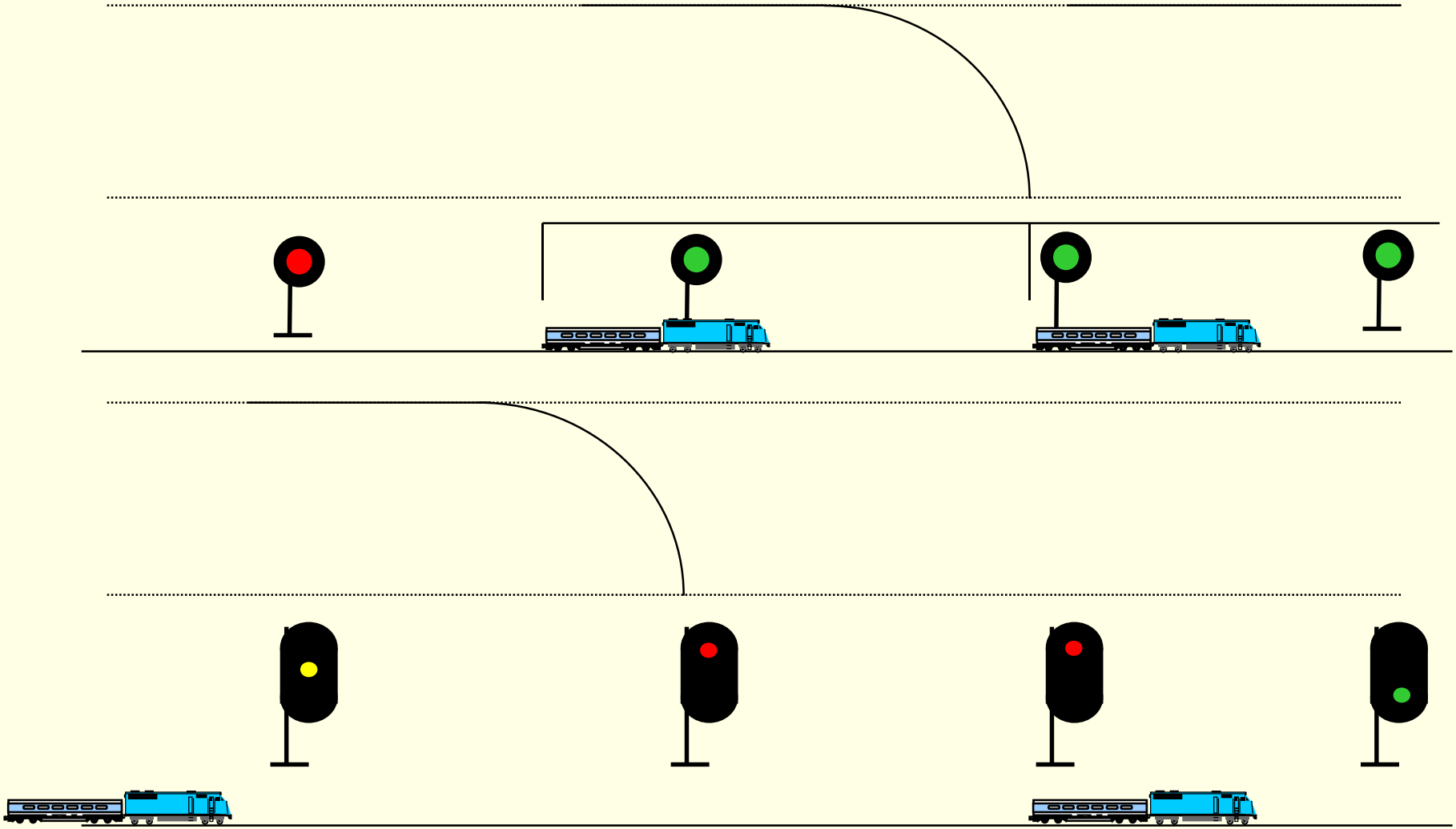
- **Safety**
  - Provides exclusive occupancy for train
  - Headway depends on braking capability
- **Operational**
  - Provides movement authority to train through in-cab display



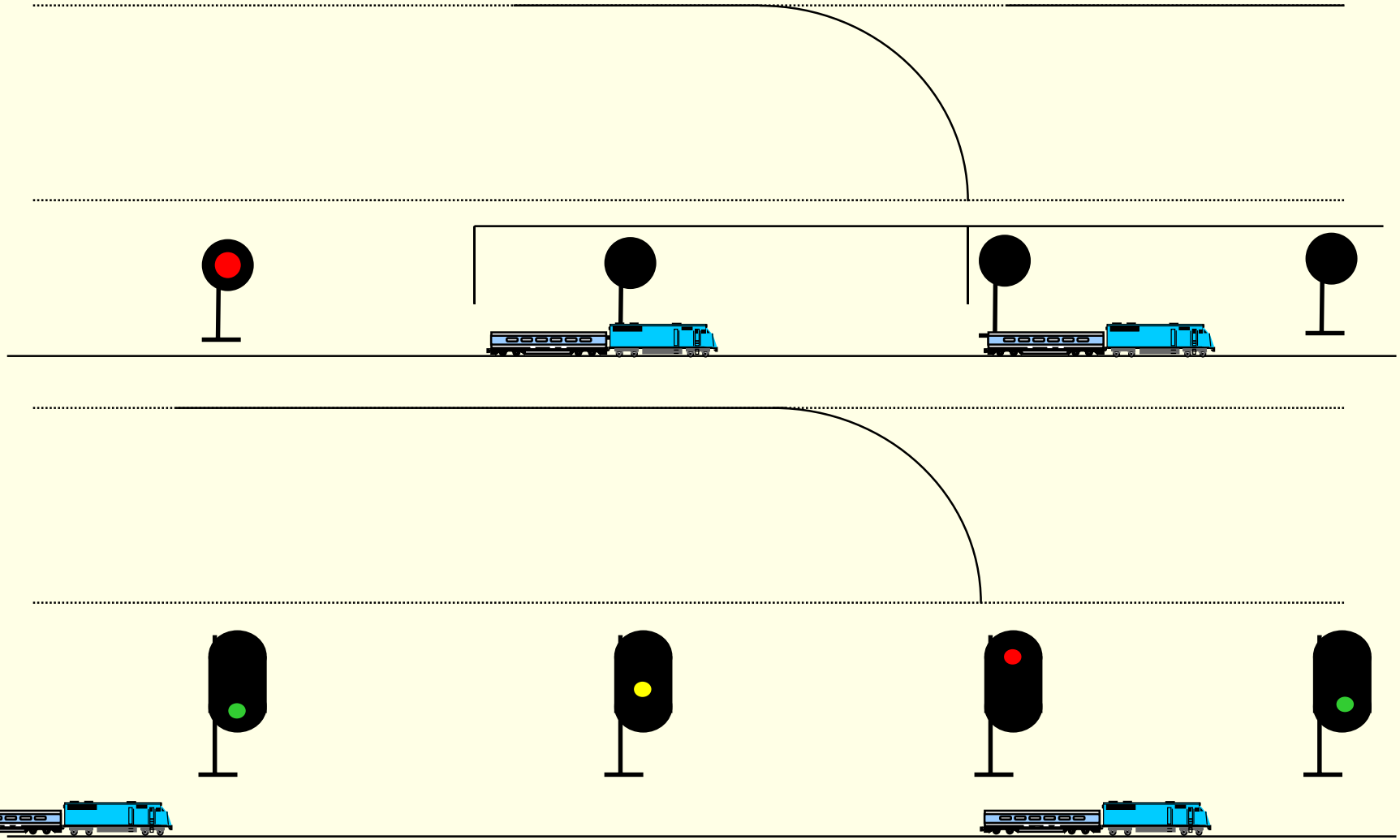
Comparison of Headways
Moving Block vs. Fixed Block



Comparison of CBTC & Conventional Signalling (1)



Comparison of CBTC & Conventional Signalling (2)



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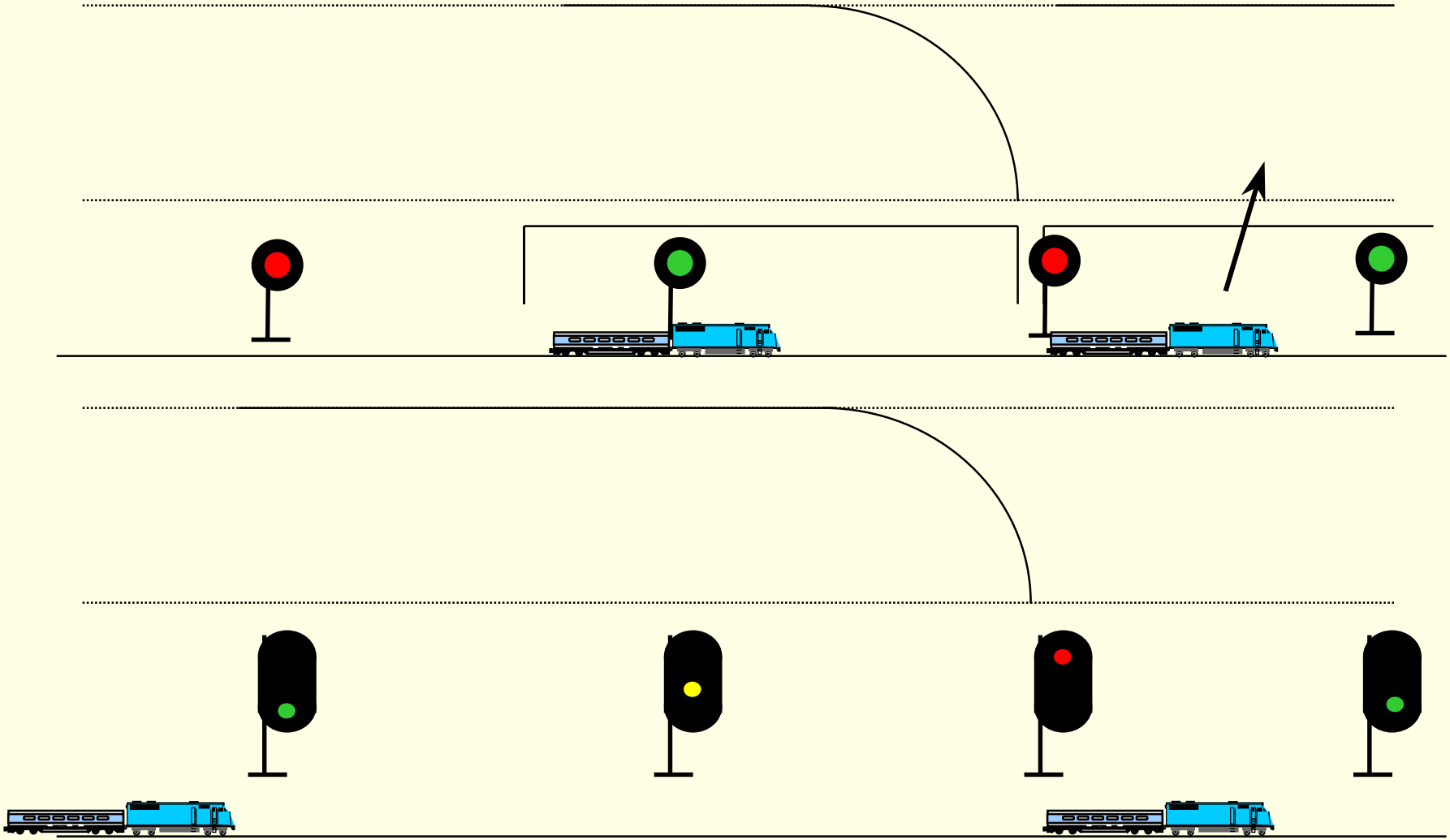
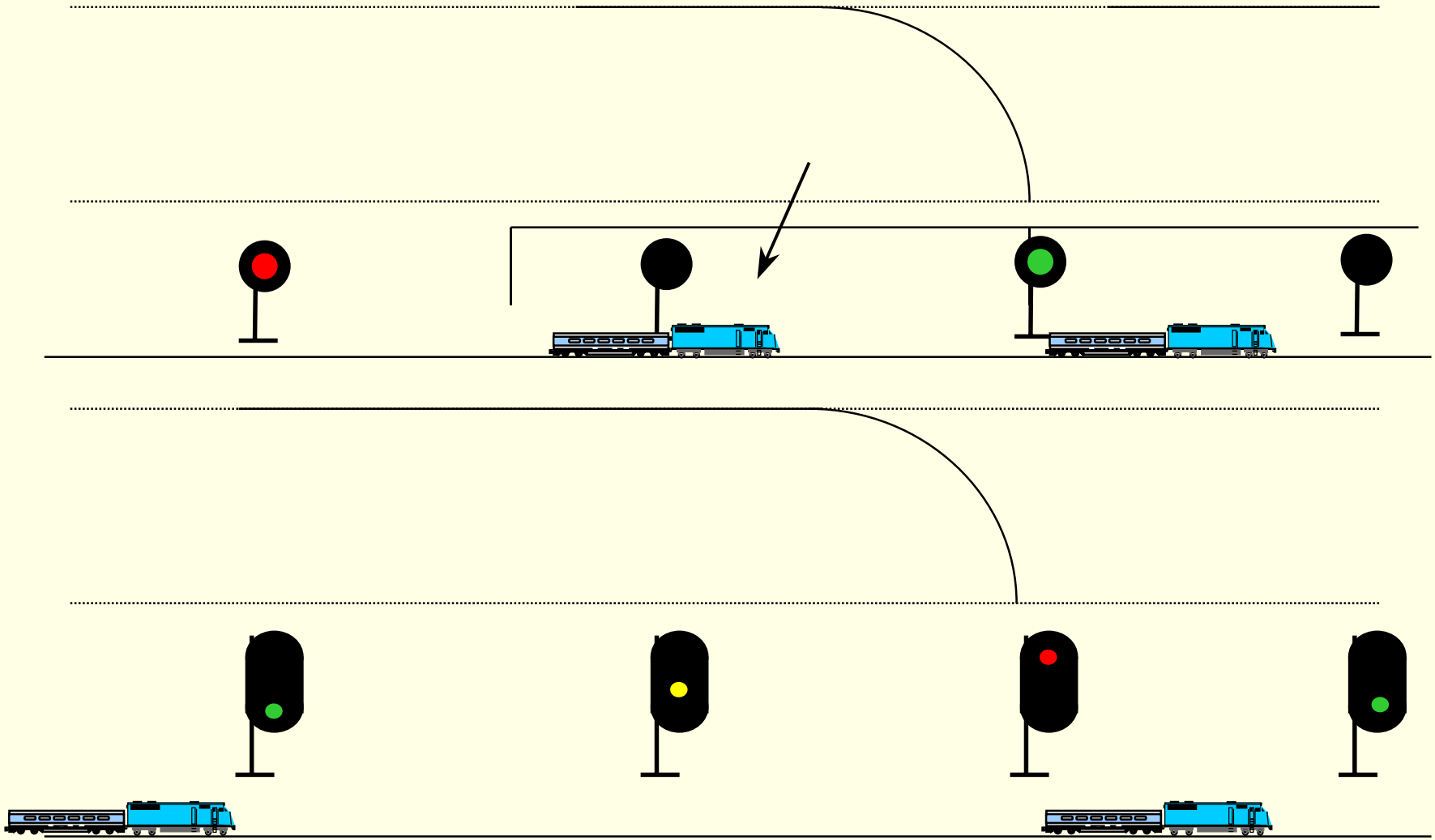
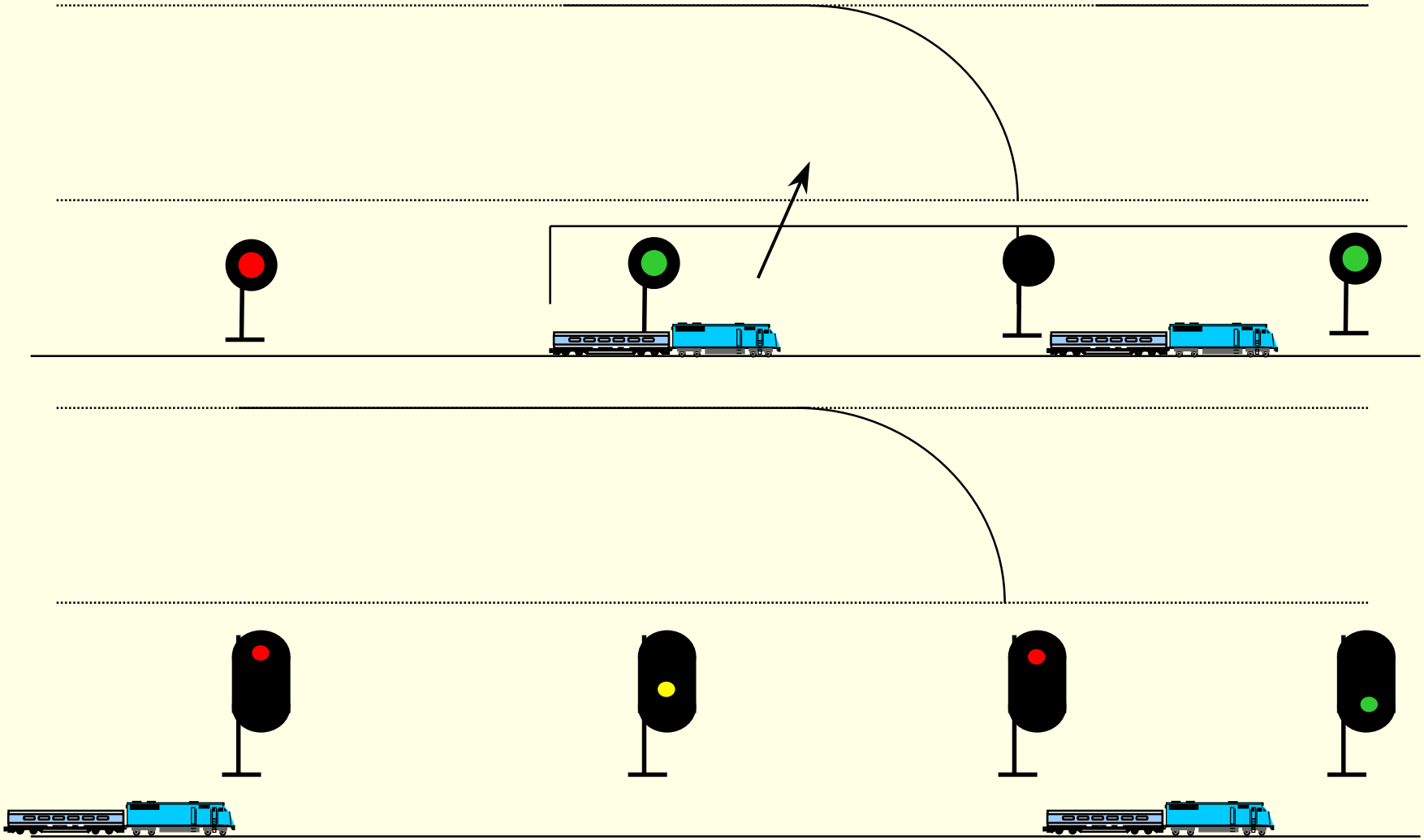


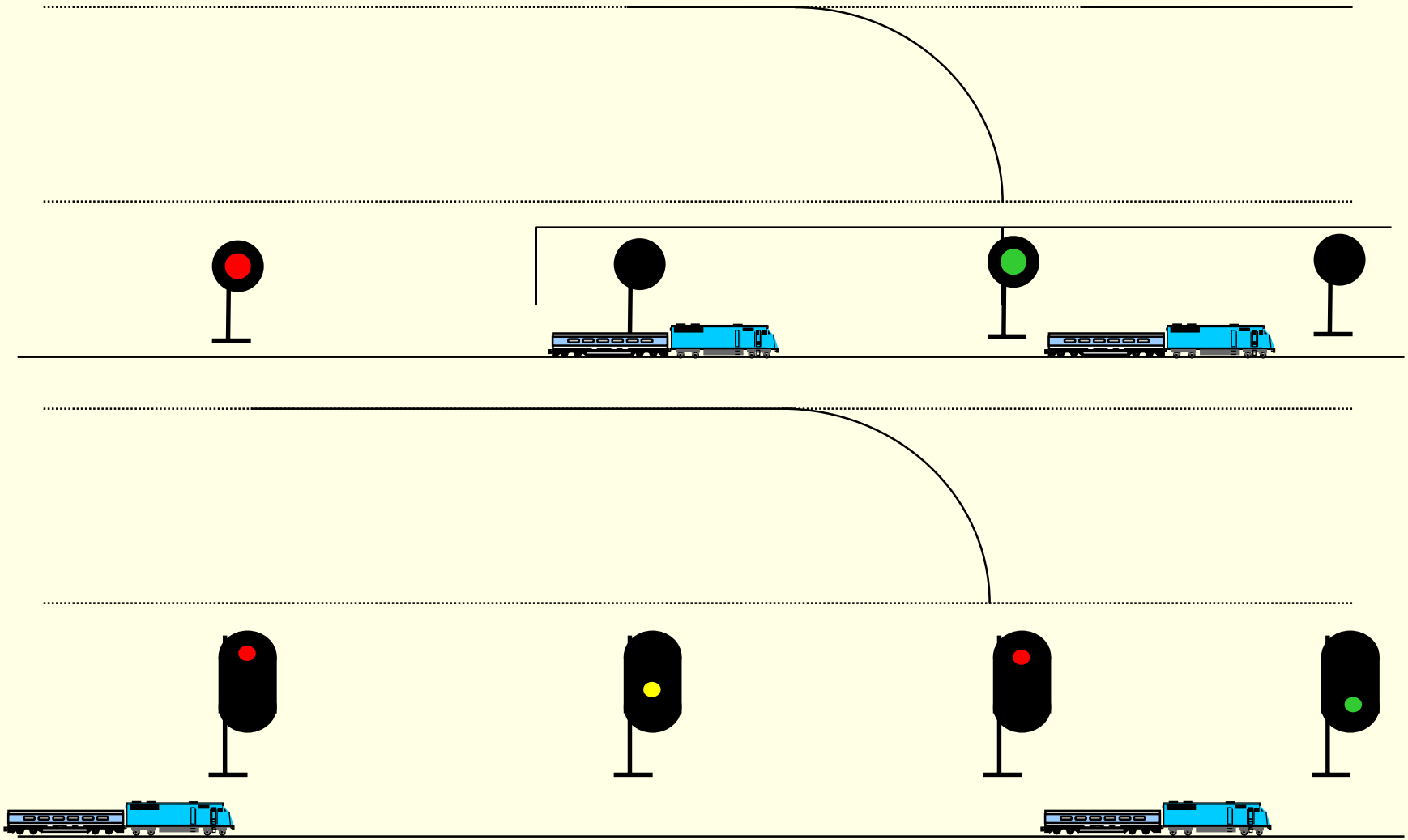
Comparison of CBTC & Conventional Signalling (4)



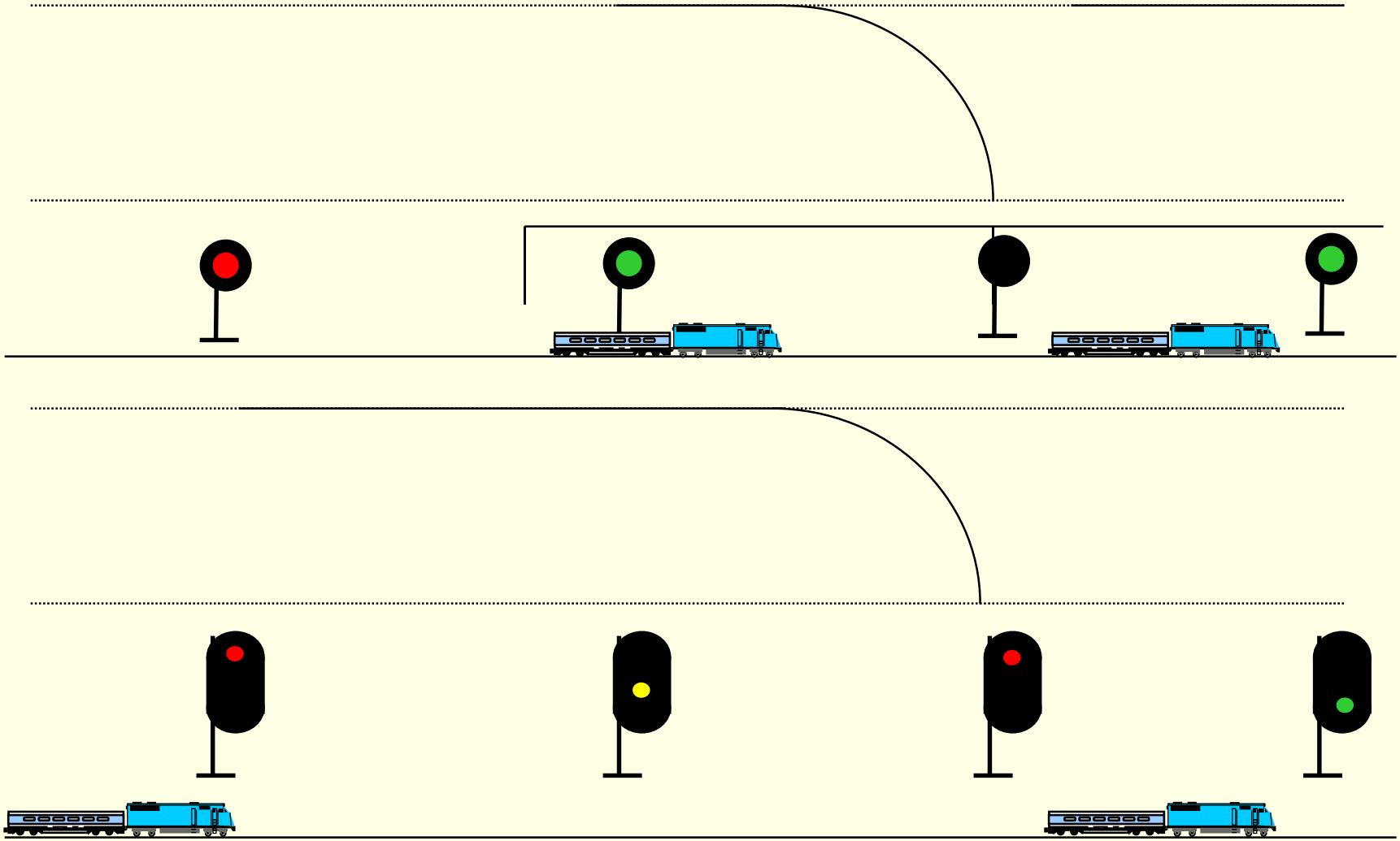
Comparison of CBTC & Conventional Signalling (5)



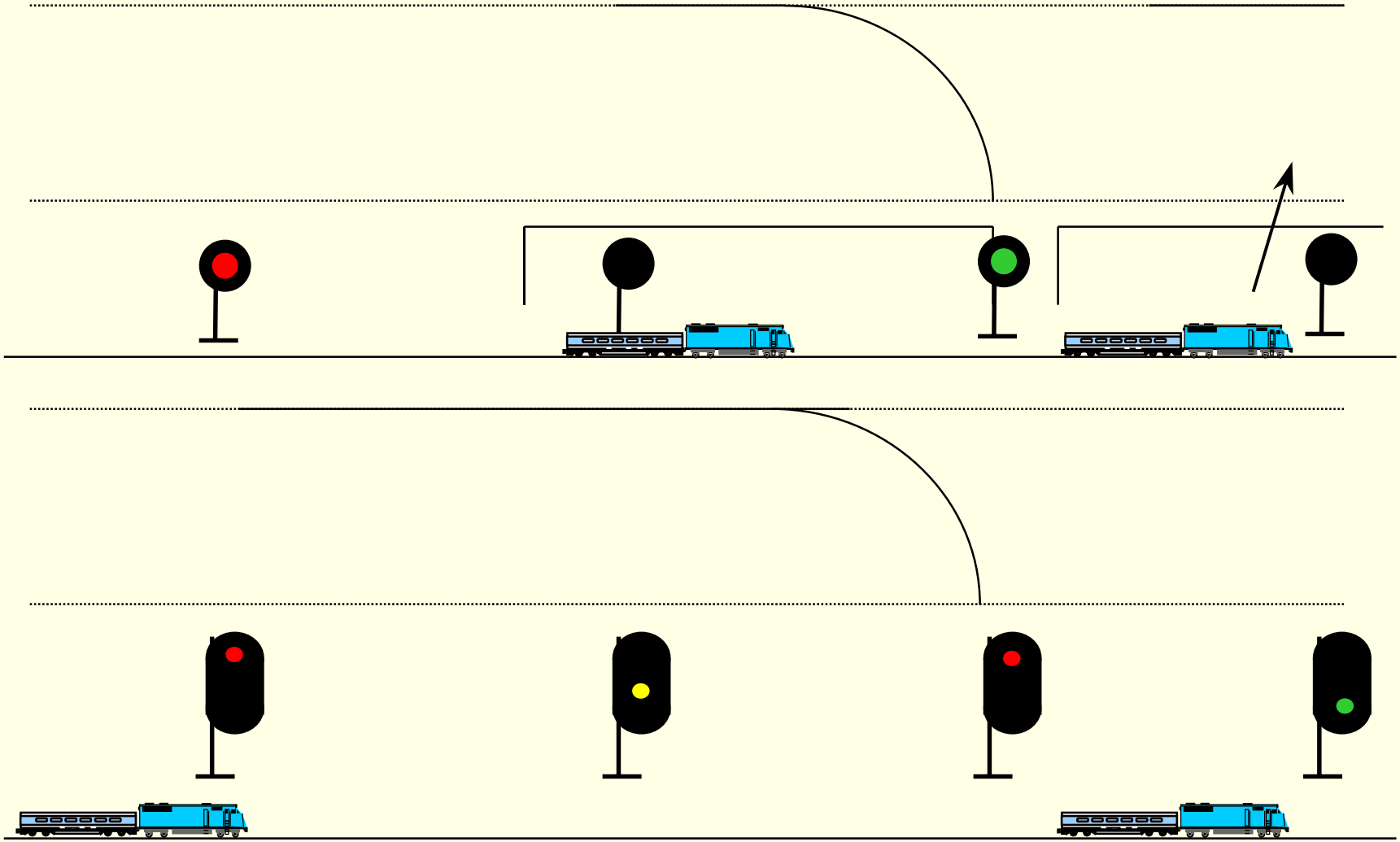
Comparison of CBTC & Conventional Signalling (6)



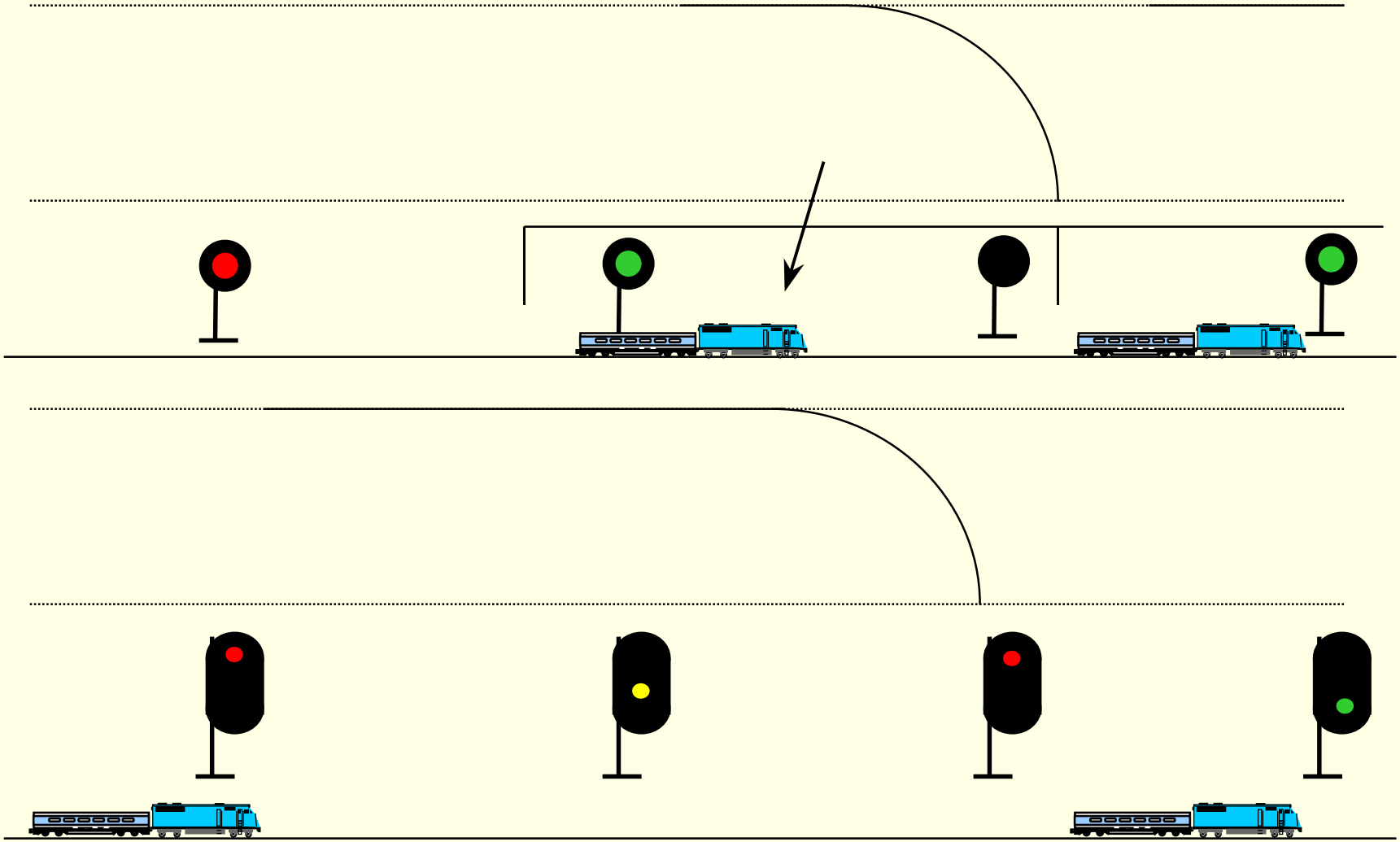
Comparison of CBTC & Conventional Signalling (7)



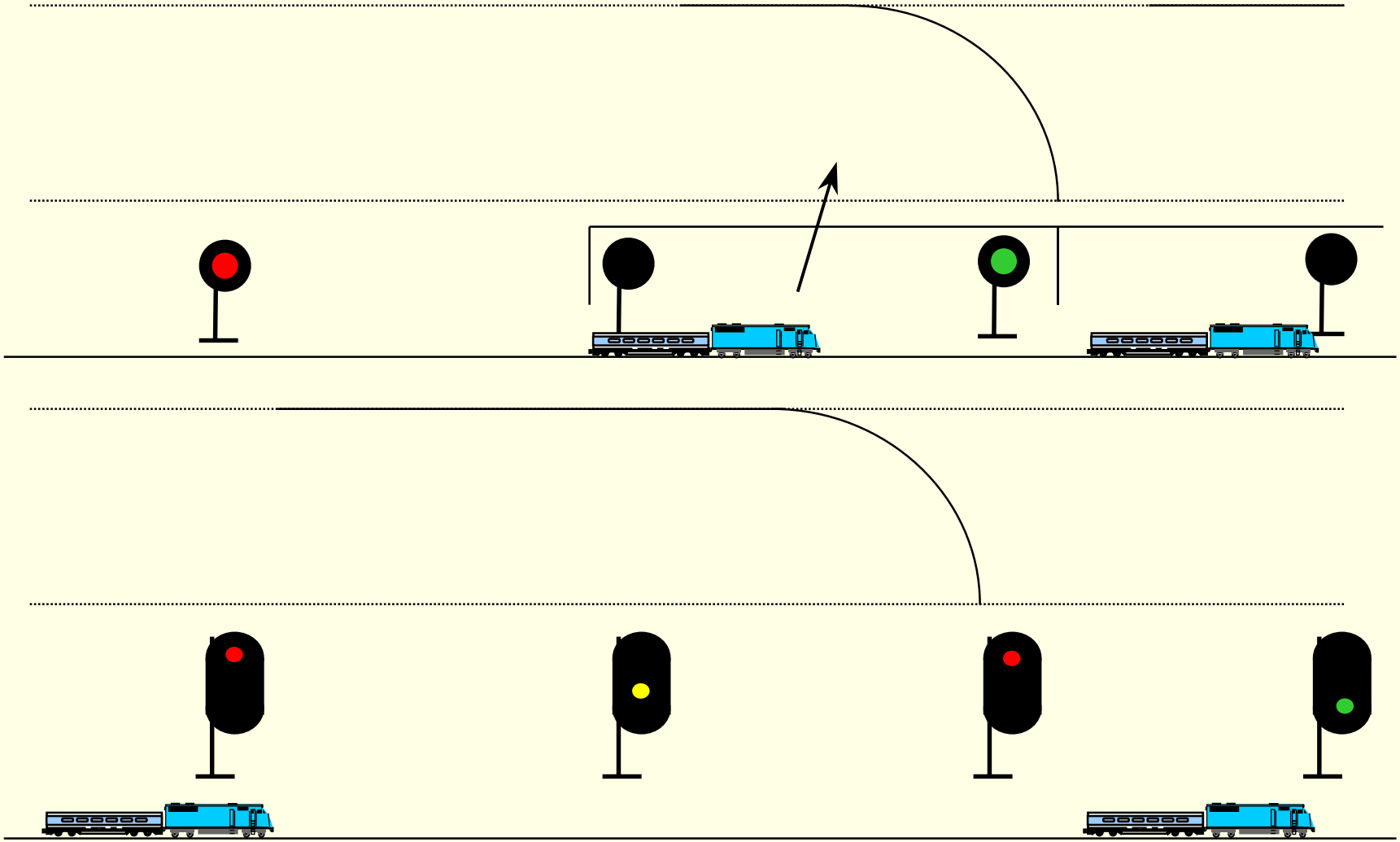
Comparison of CBTC & Conventional Signalling (8)



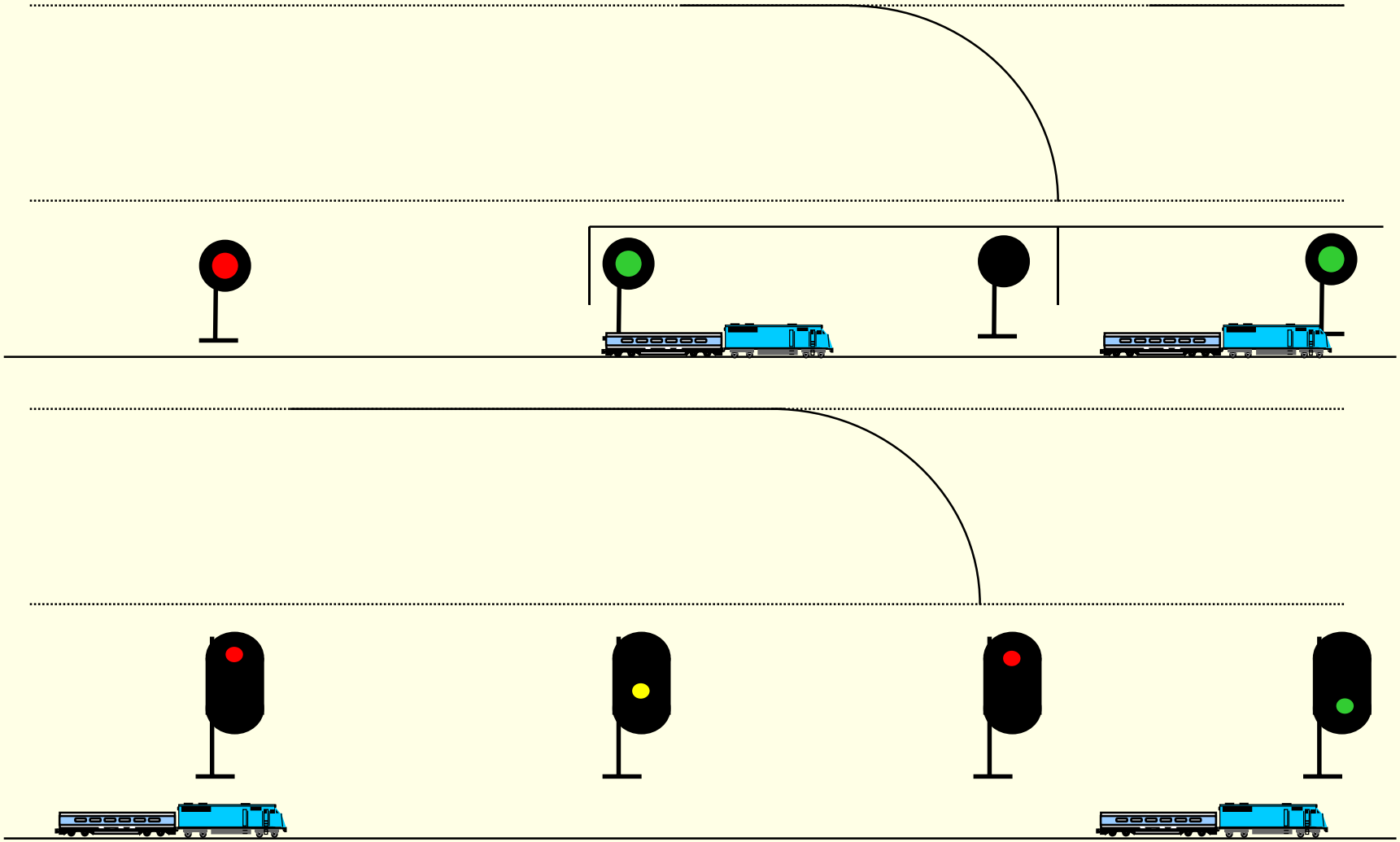
Comparison of CBTC & Conventional Signalling (9)



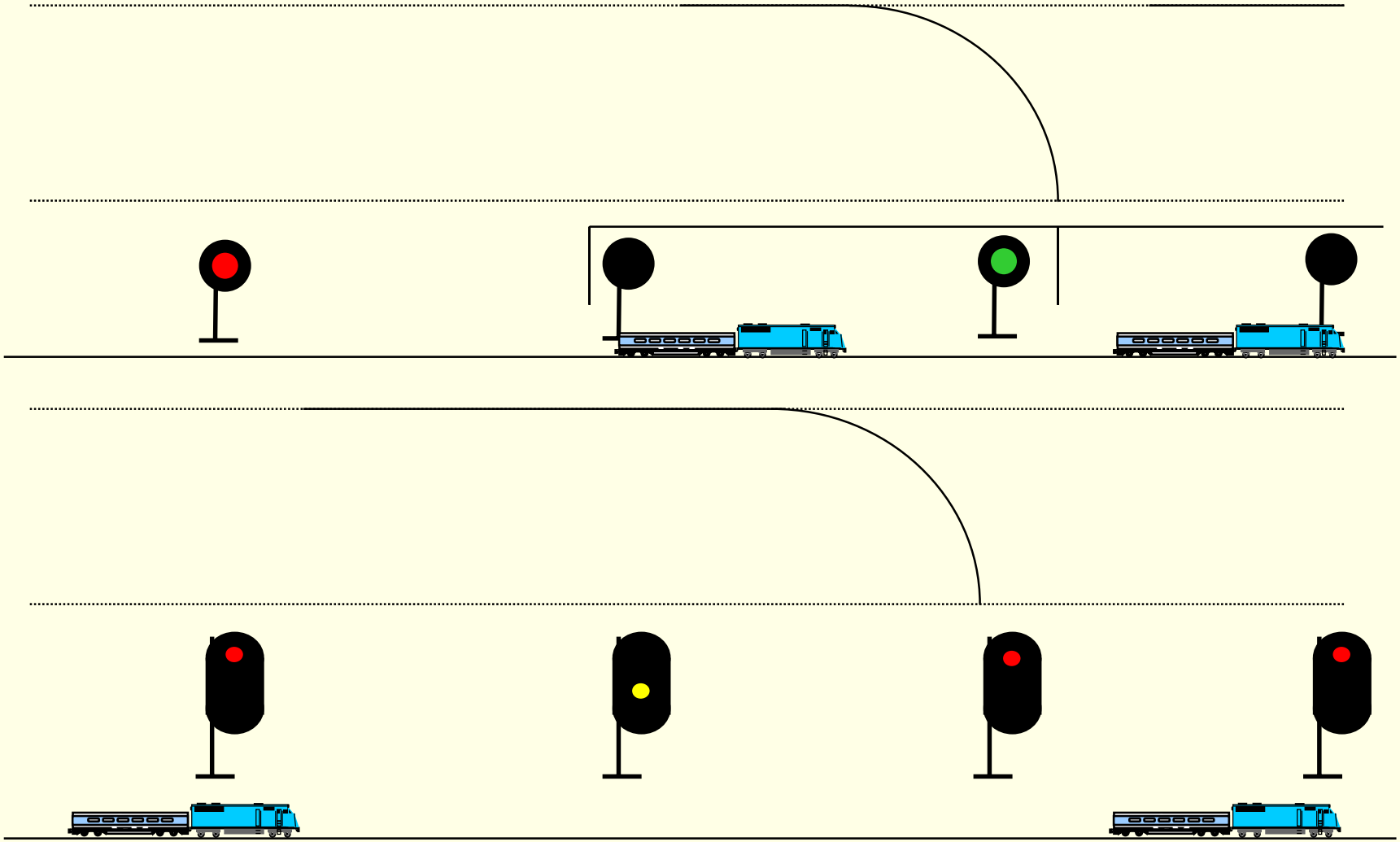
Comparison of CBTC & Conventional Signalling (10)



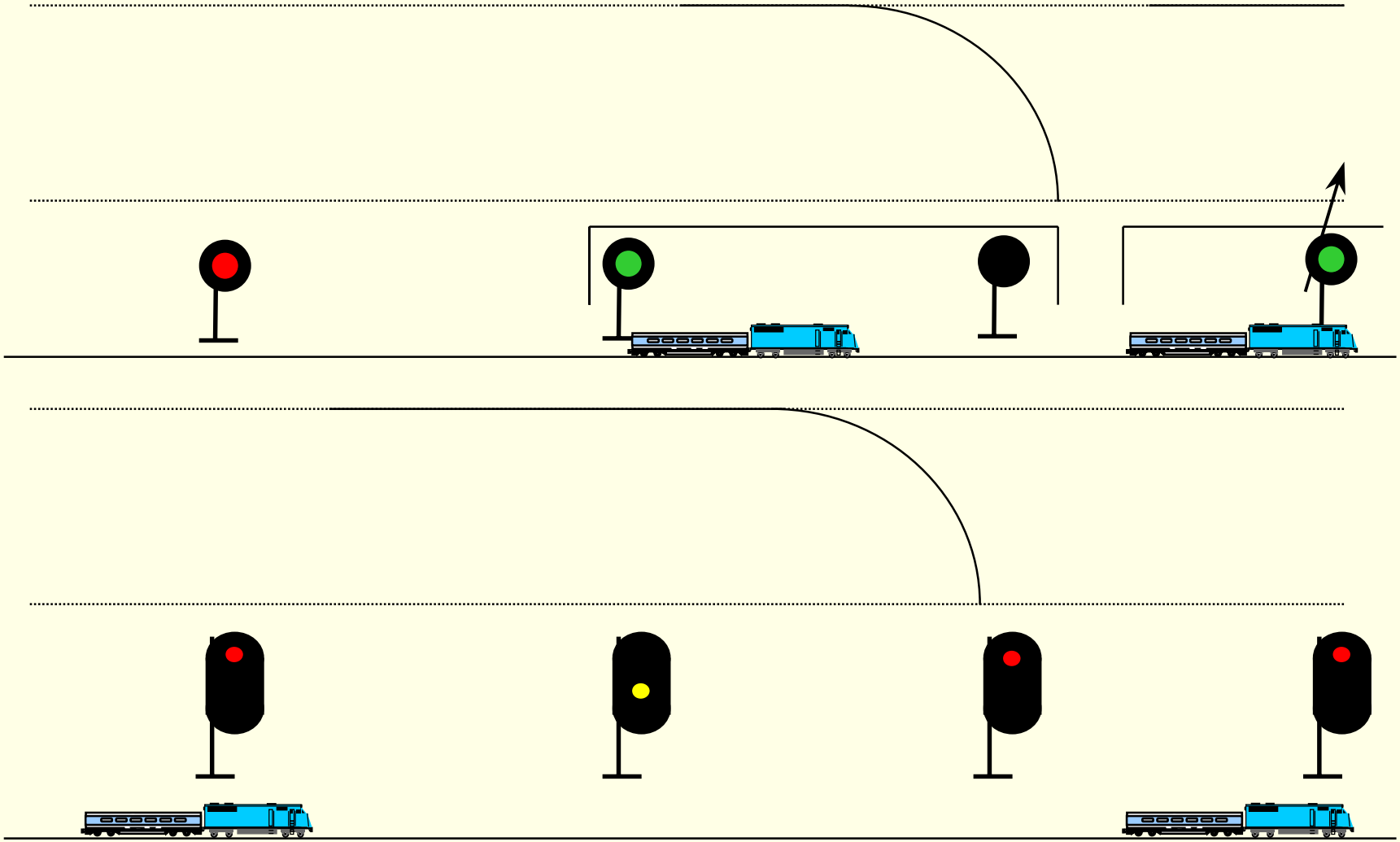
Comparison of CBTC & Conventional Signalling (11)



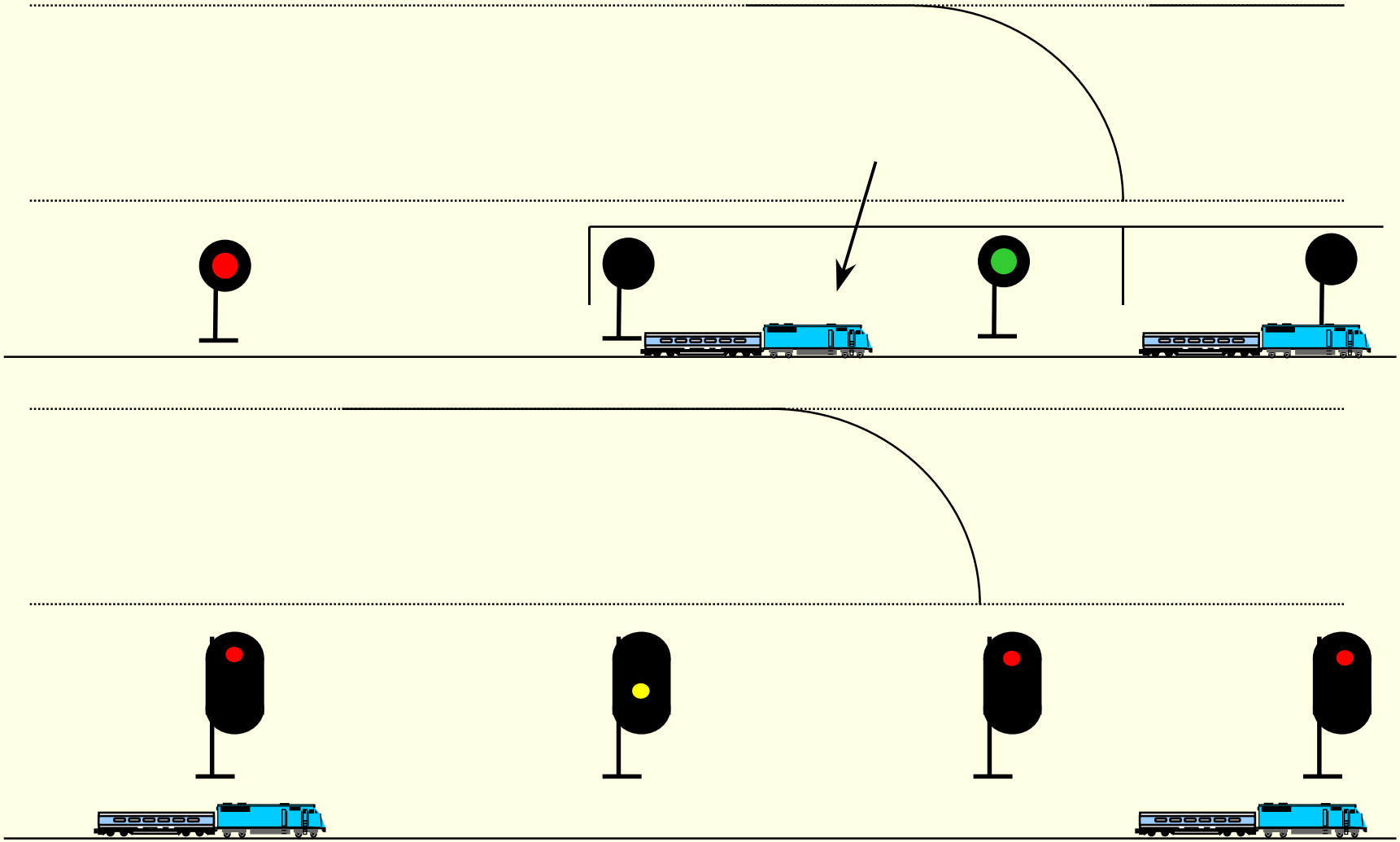
Comparison of CBTC & Conventional Signalling (12)



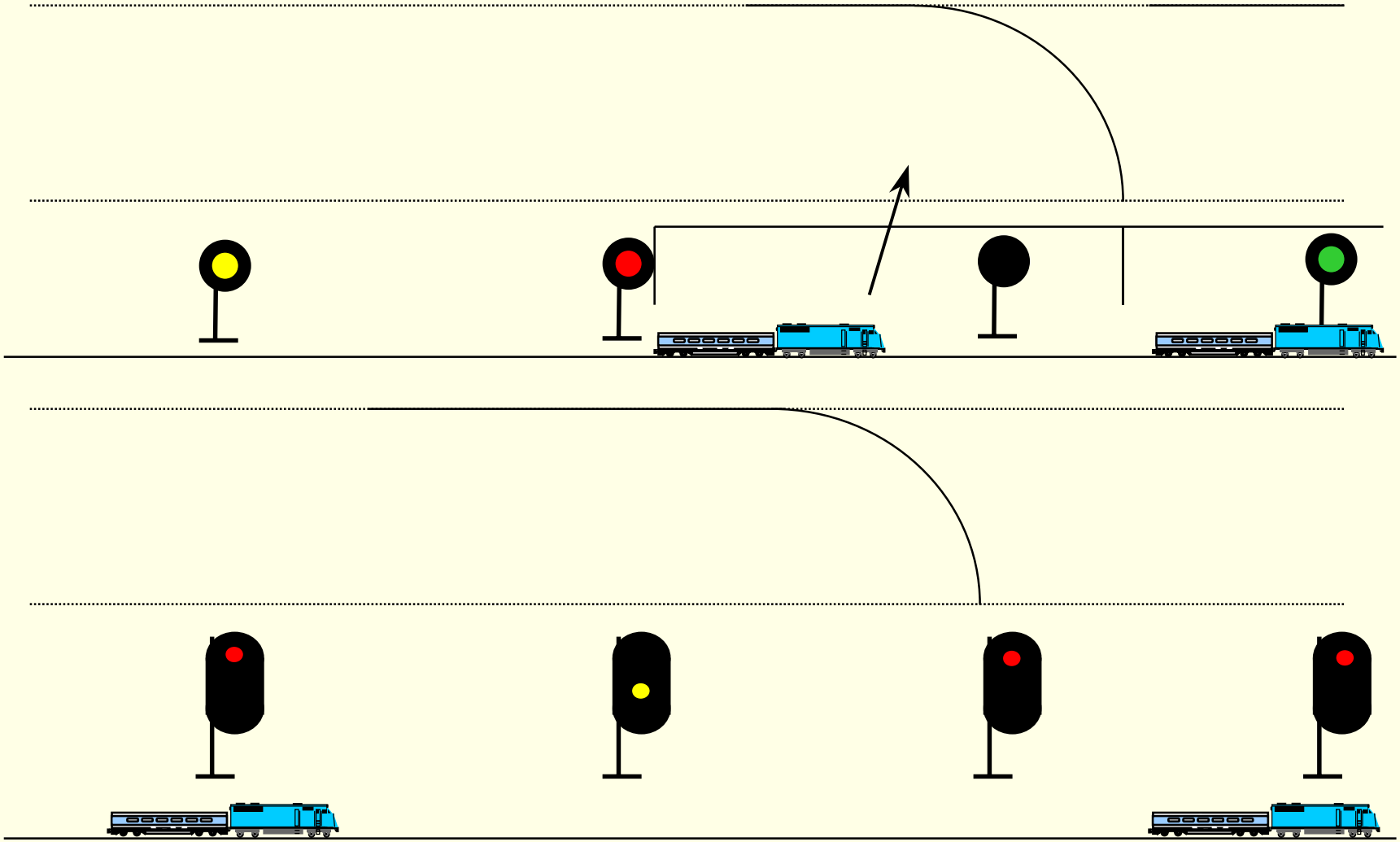
Comparison of CBTC & Conventional Signalling (13)



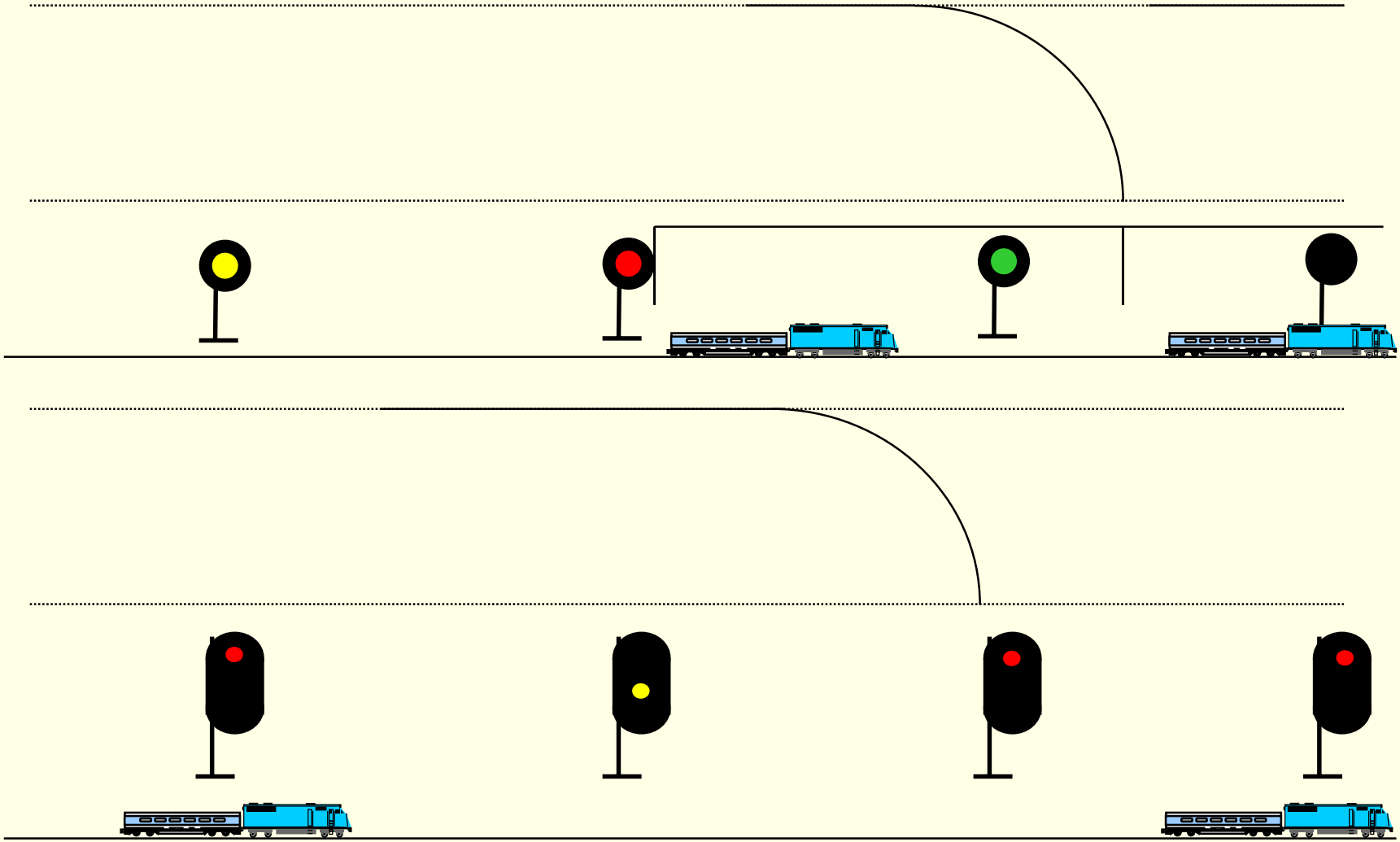
Comparison of CBTC & Conventional Signalling (14)



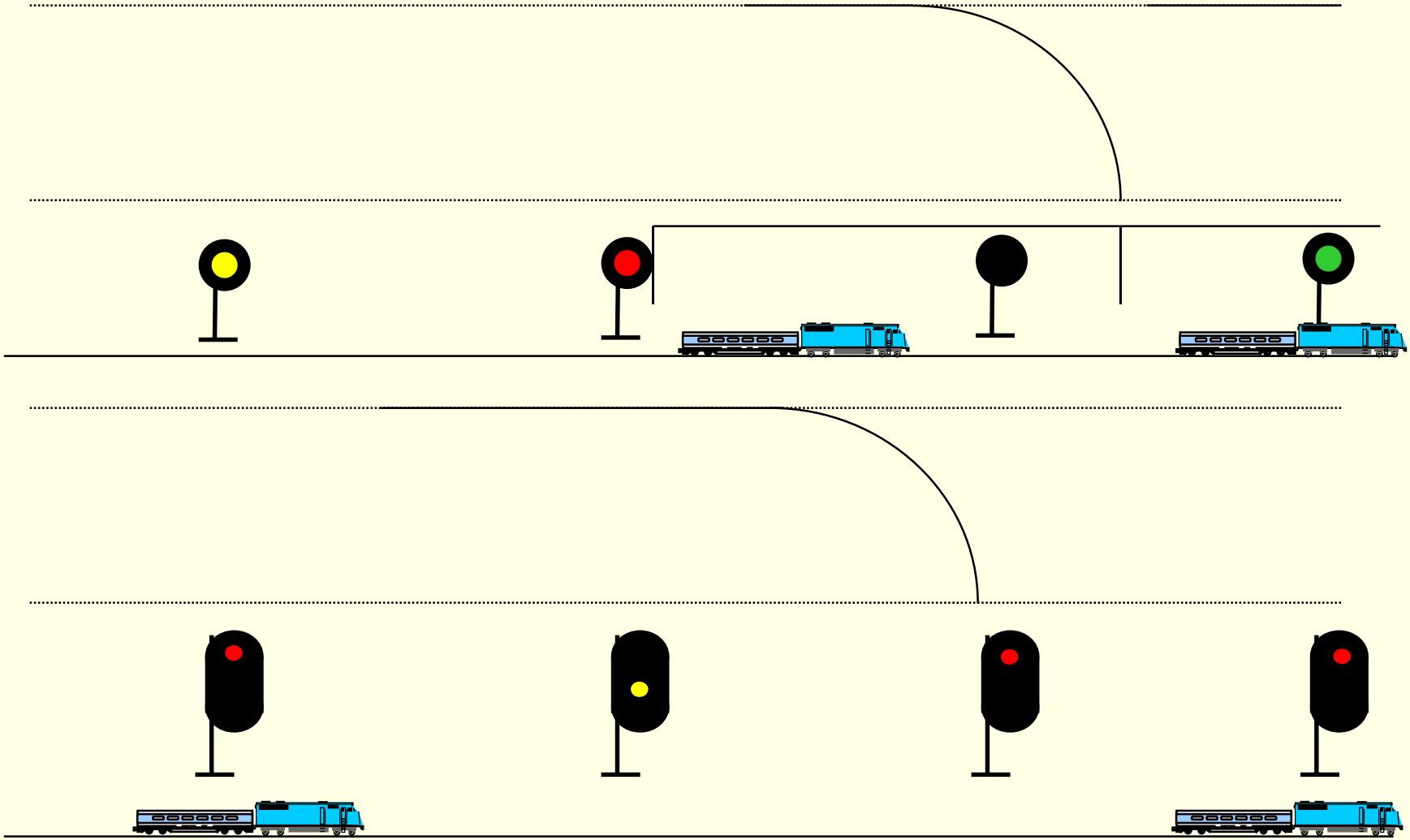
Comparison of CBTC & Conventional Signalling (15)



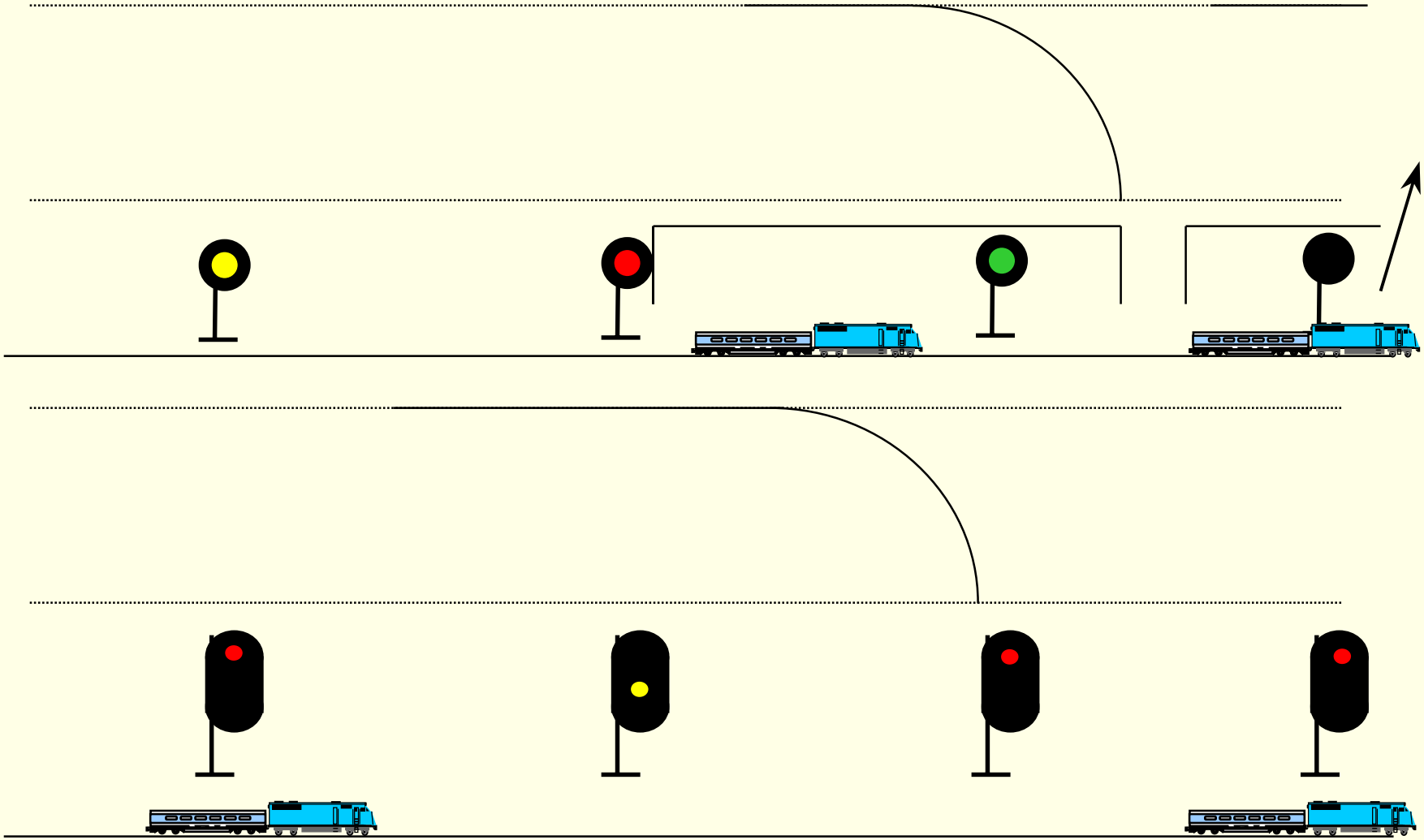
Comparison of CBTC & Conventional Signalling (16)



Comparison of CBTC & Conventional Signalling (17)



Comparison of CBTC & Conventional Signalling (18)



Advantages of Moving Block

- **Treats each train uniquely**
  - Result - higher capacity
- **Allows trains to bunch when operating more slowly**
  - Temporary Speed Restrictions
  - Approaching Yards
  - Result - higher capacity
- **Train can leave siding sooner following overtake**
  - Result - better performance
- **Overall result**
  - Better asset utilization

Route Integrity Monitoring

- **Correct position of power-operated switches will be verified as trains approach**
  - if not verifiable, MA will be withdrawn to switch
- **All hand-operated switches will be monitored through track circuits**
  - any unidentified track occupancy results in Restricted Speed Restriction
- **All hand-operated operated switches in high-speed territory electrically locked and individually monitored**
  - Stop & Inspect Restriction applied if not properly aligned

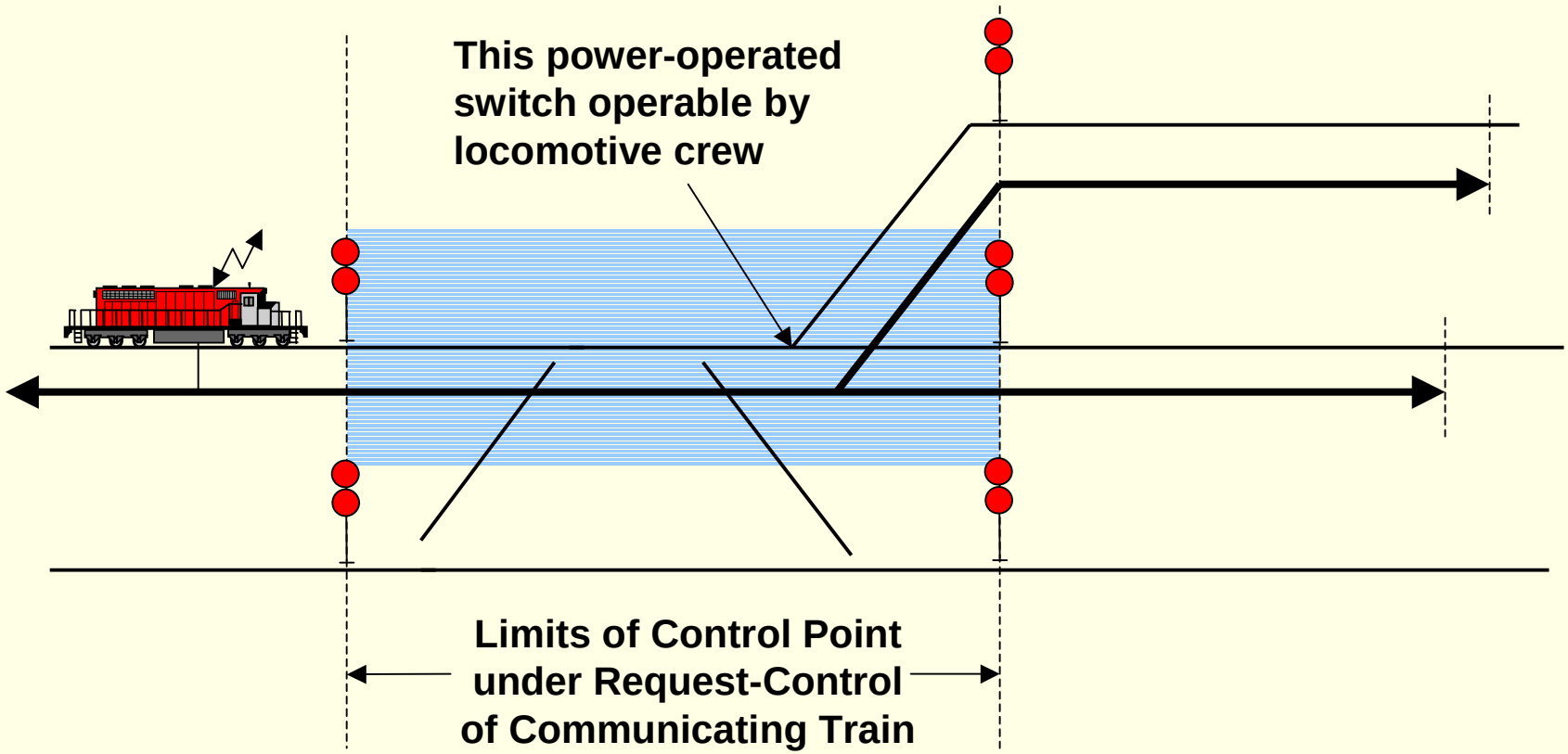
Warnings and Enforcement

- **General Principle - Enforcement always preceded by visual & audible warnings**
  - Exception - emergency situation
- **Enforcement of authorities**
  - Warnings provide countdown till enforcement
  - Loco engineer actions may slow down or reverse countdown
- **Speed enforcement**
- **Form B Work Limits**
  - Train enforced to limits if presence of limits not acknowledged

Warnings and Enforcement (cont.)

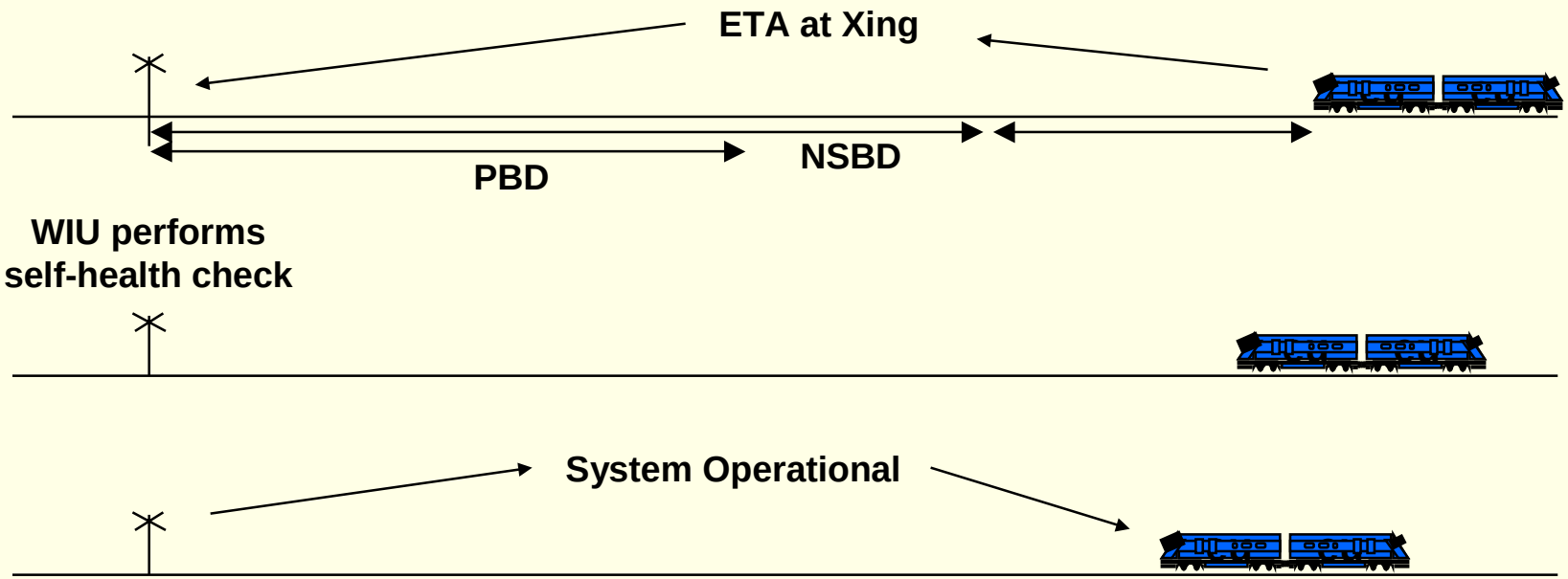
- **Enforcement is action of last resort**
  - enforcement actions will be logged showing warning location, start of enforcement, stop, reason for enforcement
  - enforcements reported to CAD

Locomotive Switch Control



- Control of switch(es) must be given by Dispatcher
- Locomotive Switch Control within WAs only
- Loco HMI will display when switch is locked
  - Permission to pass Signal at Stop not required

Advanced Activation of Crossing Warning Systems



- **Applies to all equipped trains**
- **If system not operational, Speed Restrictions applied**
  - conventional speeds if WIU not operational
  - Restricted Speed if gates down too long

Interface with Train Defect Detectors

- **Supplements normal voice-radio warnings with a message on the locomotive display**

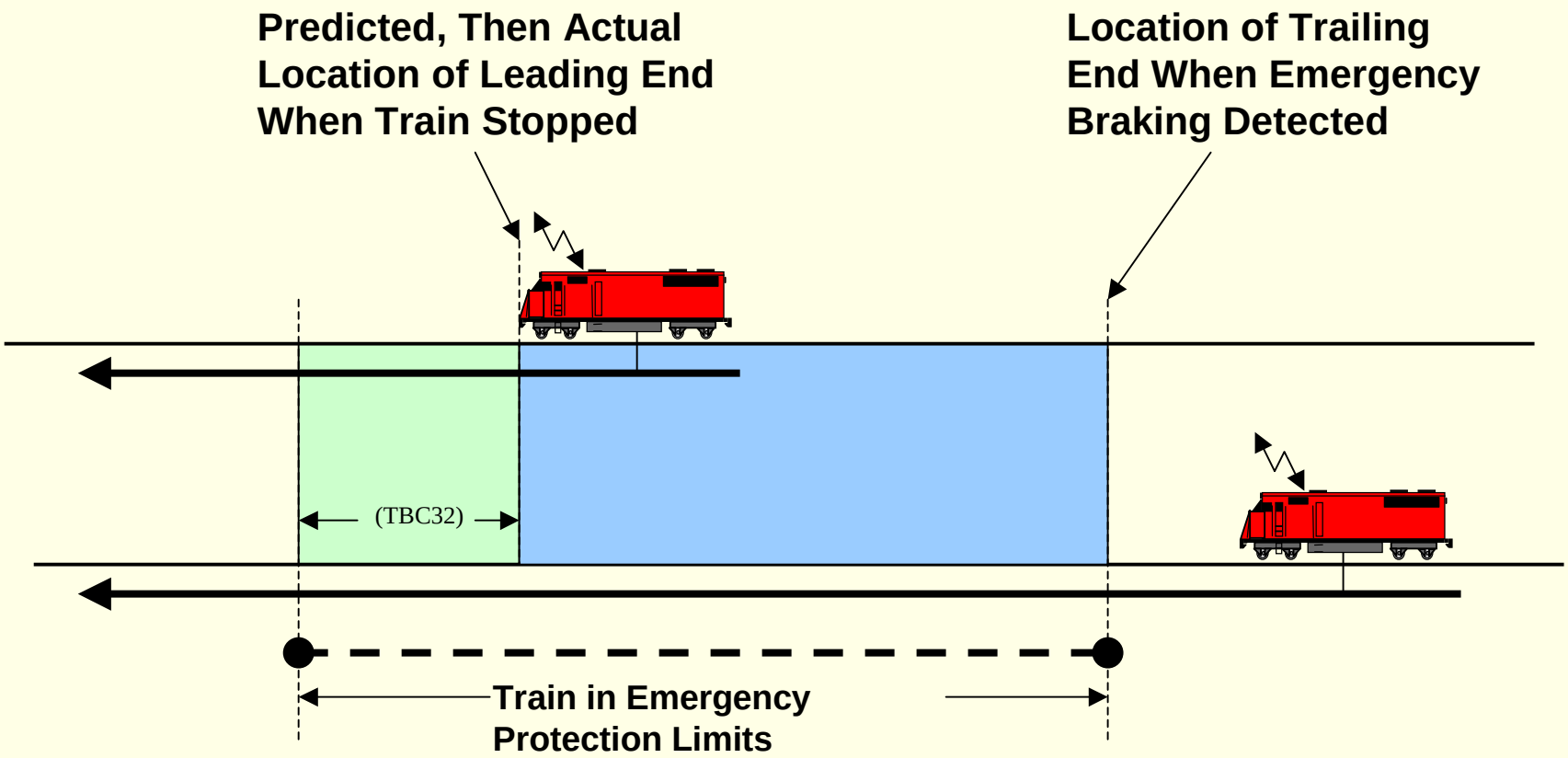
Emergency Handling

- **Detection of Unauthorized or Runaway moves**
- **Prediction of Authority Violations**
- **Actions following Emergency Brake Applications**

Detection of Unauthorized or Runaway moves

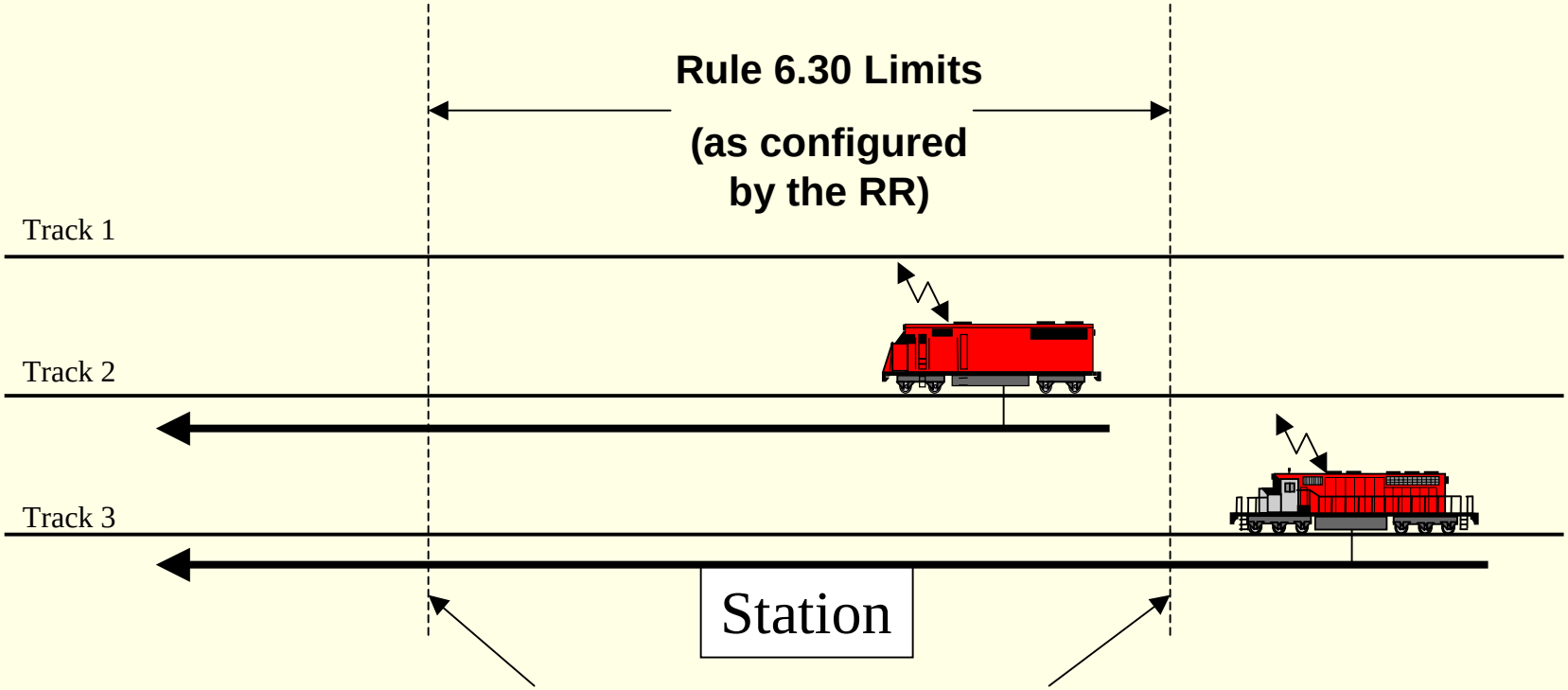
- **Detected by two successive unexplained track occupancies**
- **Dispatcher notified**
- **Authority of affected trains reduced to nearest intervening control point if there is one**
- **Otherwise, authority removed to front of train**
  - forces train to stop

System Response to Emergency Brake Application



- **Restricted Speed Restriction automatically applied to Emergency Protection Limits for 10 Minutes**

GCOR Rule 6.30 - Protection of Entraining and Detraining Passengers



Stop & Inspect Restriction

- **applied when passenger train slows to 15 mph within limits**
- **removed when passenger train reaches 20 mph following stop**

Can define applicable tracks

Pacing

- **Demonstration only**
  - CAD does not currently support
- **Provides recommended speed of operation towards point of conflict**
  - Allows for more fuel efficient operation
  - Pacing speed is advisory not instruction

Other System functions

- **Health Reporting**
- **Data Logging**

Impact on Operating Rules & Procedures

- **System designed to be very similar to operations today**
- **Procedures for locomotive engineer data entries**
- **Locomotive Control of Switches**
- **New operating rules & procedures to handle system failures**
  - communications
  - display
  - cutting out enforcement